# Technology Opportunity

## Particle Imaging Velocimetry

The National Aeronautics and Space Administration (NASA) seeks to transfer a nonintrusive optical planar velocity measurement technique.

### Potential Commercial Uses

- Measurement of flow streams (steady state and transient)
- Measurement of volumetric flow
- Measurement of air contaminants

### Benefits

The Particle Displacement Tracking (PDT) technique is a simple and inexpensive alternative to commercial Particle Imaging Velocimetry (PIV) systems. A complete setup for measuring low velocity liquid flows can be assembled for approximately $9000.00 (a personal computer (PC), a frame grabber, a Charge Coupled Device (CCD) camera, a video monitor, COSMIC software, laser, and light sheet optics). Faster moving flows can also be measured, but with higher equipment costs (high energy pulsed laser, electronically shuttered CCD camera).

### The Technology

Particle Imaging Velocimetry (PIV) is a technique for measuring the velocity of particles entrained in a flowing fluid across a planar cross section of the flow. A laser light sheet is used to illuminate the small seed particles. A Charge Coupled Device (CCD) camera is used to electronically record the light scattered from the particles. NASA Lewis Particle Displacement Tracking (PDT) software package is a simple and inexpensive PIV data acquisition and processing technique for measuring low velocity liquid flows (< 20 mm/s). The PDT software controls the data acquisition and subsequent data processing. Several image frames in sequence are acquired from the CCD camera using a frame grabber card in a PC. Fuzzy logic principles are used to track the particles from one image frame to the next, yielding the velocity of the individual particles. The nominal accuracy obtained from the particle tracking operation is 5 percent. The PDT software package is available from COmputer Software Management and Information Center (COSMIC). NASA Lewis has also developed a high velocity PIV technique which uses correlation techniques for data reduction coupled with fuzzy logic principles to perform particle tracking. The low speed PDT technique has been used to reduce data obtained from the Surface Tension Driven Convection Experiment (STDCE) on space shuttle mission U.S. Microgravity Laboratory 1 (USML-1). Several universities, commercial customers, and other NASA centers, have procured and implemented the PDT software for use in research programs. Fluid velocity fields have been measured inside of heated fluid reservoirs, as have molten glass flows inside glass ovens (magnetohydrodynamic flows). Combusting zero-gravity flows and two-phase particulate flows have also been measured. In addition to the PDT software package available from COSMIC, a commercial frame grabber manufacturer, EPIX, Inc. (phone (847) 465-1818), has implemented the PDT algorithm in their interactive menu software entitled “4MIP.” The particle tracking feature is a menu option along with other image processing operations. The user specifies the paramenters for the tracking operation, and the software draws the detected velocity vectors on top of the raw particle image.

The high speed version of the technique has been used to measure supersonic nozzle flows. The PDT COSMIC package lists the commercial hardware required to implement the PIV data acquisition and reduction system. The illumination requirements are not covered in the PDT package; however, many references on light sheet generation are available in the open literature.

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## Options for Commercialization

The Particle Displacement Tracking (PDT) software package is available from COSMIC as LEW-14925.

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## Key Words

Velocity measurement
Particle velocimetry
Laser anemometry

M-0239-86


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Space Administration
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